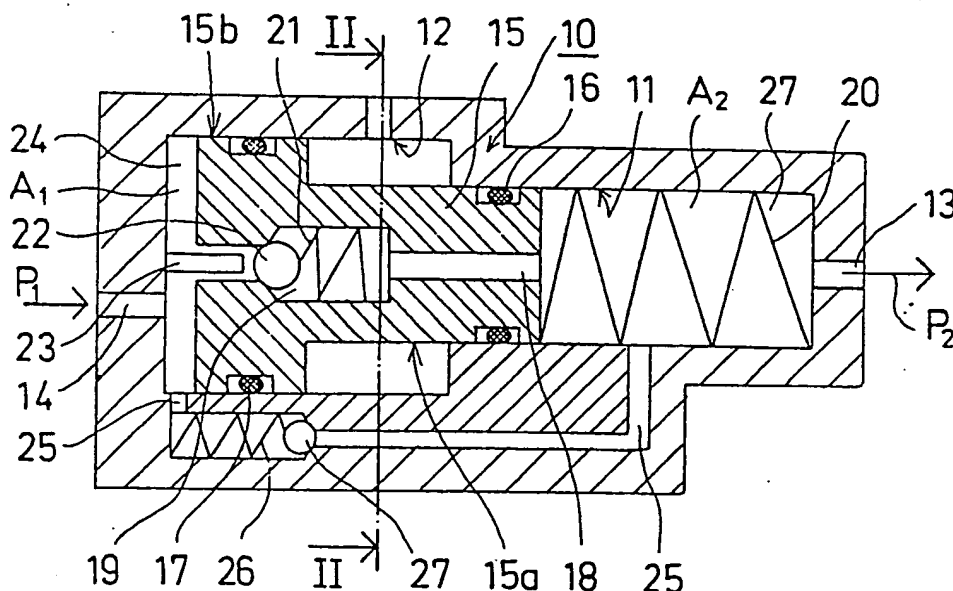




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification: <b>B60T 11/28</b>	<b>A1</b>	(11) International Publication Number: <b>WO 81/01692</b> (43) International Publication Date: <b>25 June 1981 (25.06.81)</b>
<p>(21) International Application Number: <b>PCT/FI80/00012</b></p> <p>(22) International Filing Date: <b>4 December 1980 (04.12.80)</b></p> <p>(31) Priority Application Number: <b>79 3829</b></p> <p>(32) Priority Date: <b>7 December 1979 (07.12.79)</b></p> <p>(33) Priority Country: <b>FI</b></p> <p>(71) Applicant (for all designated States except US): <b>VALMET OY [FI/FI]; Punanotkonkatu 2, SF-00130 Helsinki 13 (FI).</b></p> <p>(72) Inventors; and (75) Inventors/Applicants for US only): <b>MÄKITALO, Seppo [FI/FI]; Ketunpolku 12, SF-40400 Jyväskylä 40 (FI). TAPANILA, Alpo [FI/FI]; Väliaitankatu 6 C 24, SF-40300 Jyväskylä 30 (FI).</b></p> <p>(74) Agent: <b>FORSSÉN &amp; SALOMAA OY; Uudenmaankatu 40, SF-00120 Helsinki 12 (FI).</b></p>		<p>(81) Designated States: <b>BR, DE (European patent), FR (European patent), GB (European patent), SE (European patent), US.</b></p> <p><b>Published</b> <i>With international search report</i> <i>In English translation (filed in Swedish)</i></p>

**COPY**(54) Title: **PRESSURE CONVERTER FOR HYDRAULIC BRAKES, PARTICULARLY FOR TRACTORS**

(57) Abstract

Pressure converter for hydraulic brakes, particularly for brakes of a tractor. The converter comprises a body (10), a piston device (15) reciprocating in the borings of the body, a primary compartment (24), and a secondary compartment (27). The area of the cross-section of the piston in the primary compartment (24) is essentially larger than the area of the cross-section of the piston in the secondary compartment (27). The primary pressure ( $p_1$ ) is conducted to the primary compartment from the brake system master cylinder, and the amplified secondary pressure is conducted from the secondary compartment to the wheel cylinders. In order to avoid a too high secondary pressure for instance in steering brake operation, and in order to make it possible to use a high conversion ratio, the pressure converter is equipped with a pressure-limiting organ (25, 26, 27), by means of which the secondary pressure is limited according to the highest maximum allowed secondary pressure. The conversion ratio ( $A_1/A_2$ ) of the pressure converter is also selected high enough to essentially provide the maximum allowed secondary pressure with primary pressures available in normal brakings.

***FOR THE PURPOSES OF INFORMATION ONLY***

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	KP	Democratic People's Republic of Korea
AU	Australia	LI	Liechtenstein
BR	Brazil	LU	Luxembourg
CF	Central African Republic	MC	Monaco
CG	Congo	MG	Madagascar
CH	Switzerland	MW	Malawi
CM	Cameroon	NL	Netherlands
DE	Germany, Federal Republic of	NO	Norway
DK	Denmark	RO	Romania
FI	Finland	SE	Sweden
FR	France	SN	Senegal
GA	Gabon	SU	Soviet Union
GB	United Kingdom	TD	Chad
HU	Hungary	TG	Togo
JP	Japan	US	United States of America

Pressure converter for hydraulic brakes, particularly for tractors

The present invention relates to a pressure converter for hydraulic brakes, particularly for brakes of a tractor, which converter comprises a body and a piston device located in the borings or similar of the body, which piston device has a primary compartment and  
5 a secondary compartment, the piston of the primary compartment having an essentially larger area of the cross-section than the secondary compartment, and the primary pressure being conducted to the primary compartment from the brake system master cylinder or similar, and the amplified secondary pressure being conducted from the secondary com-  
10 partment to the wheel cylinder.

It is a well-known arrangement to use a hydraulic pressure converter (pressure amplifier) in the brake system of a vehicle for the provision of a sufficient braking force with available pedal forces.  
15 Known pressure converters for brakes operate in two phases in such a way that, at first, the brake linkage clearances are closed with a small hydraulic conversion ratio or with hydraulic conversion ratio = 1, and then the hydraulic conversion ratio is so increased as to provide a sufficient force in order to compress the braking compo-  
20 nents against each other.

In tractors and similar equipment it is usual to use steering brake, which means that the brake pedal comprises two parts which can be coupled together. In the coupled position brakes are applied to both  
25 rear wheels. After opening said coupling either of two pedals can be pressed braking effect being consequently applied to one of the rear wheels of the tractor only. When using the steering brake operation, such peak pressures can occur in the master cylinder that are about two times higher than those occurring in a normal braking. Without  
30 special arrangements, the brake equipment has to be dimensioned according to this peak pressure. So, in known brake equipment the conversion ratio of the pressure converter is determined by the allowed maximum pressure of the brake circuit.

An objective of the present invention is to provide such a pressure converter for brakes, particularly for the brakes of a tractor, that allows higher conversion ratios than before for higher secondary pressures with lower primary pressures than before. Another objective is to provide such a pressure converter in which the maximum allowed secondary pressures are not exceeded even when using steering braking or in other similar situations.

For attaining the objectives mentioned above, the principal characteristic feature of the invention is that the pressure converter is equipped with pressure-limiting organs, by means of which the secondary pressure is limited according to the maximum allowed secondary pressure, and that the conversion ratio of the converter is selected high enough to essentially provide the maximum allowed secondary pressure with primary pressures available in normal brakings.

Embodiments of the invention will now be described in detail, by way of examples only, with reference to the accompanying drawings, with no intention to restrict the invention to these details.

Figure 1 is an axial-section view of a pressure converter in accordance with the invention. At the same time, figure 1 shows section I-I in figure 2.

Figure 2 shows section II-II in figure 1.

Figure 3 shows the characteristic pressure curve of a converter in accordance with the invention.

A pressure converter illustrated in the figures comprises a body part 10, in which there is one cylindrical boring 11 and another cylindrical boring 12 of a larger diameter. In said borings 11, 12 there is piston 15, whose cylindrical part 15a fits into boring 11 and cylindrical part 15b fits into the larger boring 12. In cylindrical parts 15a and 15b there are sealings 16 and 17. Primary pressure  $p_1$  is conducted to primary side 24 of the converter from the master cylinder (not shown) to whose piston the movement is

transmitted from brake pedals. Primary pressure  $p_1$  is conducted to primary compartment 24 through opening 14, and secondary pressure  $p_2$  of the secondary compartment is conducted through opening 13 to the wheel cylinder (not shown).

5

Within boring 18 of piston 15 there is a valve comprising spring 21 and valve ball 22. As, in figure 1, piston 15 is in the unloaded position, in which position primary pressure  $p_1 = 0$ , piston 15 is, being pressed by spring 20 located in compartment 27, in a position in which pin 23 pushes valve ball 22 to an open position. As, in this position, primary pressure  $p_1$  begins to be increased, primary pressure  $p_1$  influences, through valve 21,22 that has been opened, and channel 18, directly to secondary compartment 27, in which case the conversion ratio of the converter is  $p_2/p_1 = 1$ . Now the converter operates in the lower part of the characteristic curve shown in figure 3, along line  $p_1 = p_2$  up to points  $p_{20}$  and  $p_{10}$  (area I). As, in primary compartment 24, primary pressure  $p_1$  grows high enough to be able to overcome the counterpressure of spring 20, piston 15 begins to move to the right in figure 1, and valve 21,22 is closed. In figure 1, piston 15 has moved enough to make said valve be closed, in which case the converter operates in area II of the characteristic curve shown in figure 3, the conversion ratio now being  $p_2/p_1 = A_1/A_a$ , where  $A_1$  is the piston area of the primary compartment and  $A_2$  is the piston area of the secondary compartment.

25

As shown in figure 3, with primary pressure  $p_{11}$  it is possible to provide the maximum secondary pressure  $p_{2max}$ , after which, as primary pressure  $p_1$  is further increased, the converter operates in part III of the characteristic curve. This function is brought about as follows: Channel 25 connects secondary compartment 27 to the primary compartment. This channel is fitted with a valve device comprising spring 26 and valve ball 27. The stiffness of spring 26 is so selected as to make said pressure-limiting valve start to function at a certain, preferably adjustable, maximum secondary pressure  $p_{2max}$ . The secondary pressure  $p_2$  cannot rise higher than pressure  $p_{2max}$ , and the flat section III of the characteristic curve is carried out. Then, although primary pressure  $p_1$  rises higher than

35

pressure  $p_{11}$ , for instance to pressure  $p_{1\max}$ , the secondary pressure will not exceed the highest allowed secondary pressure  $p_{2\max}$ . For instance in tractor use,  $p_{1\max}$  means the maximum primary pressure that may occur in steering-brake operation.

5

As obvious from figure 3, the maximum secondary pressure  $p_{2\max}$  is provided by the highest available pressure  $p_{11}$  already occurring in the normal brake operation. If a pressure converter equipped with a pressure-limiting function, similar to that described above, were not used, the highest practicable converting ratio of the converter would be the one indicated by phantom line  $p_{2S}$ , should one wish to avoid the exceeding of the maximum secondary pressure  $p_{2\max}$  also at the highest occurring primary pressures  $p_{1\max}$ . In a normal brake operation with the highest available primary pressure  $p_{11}$ , characteristic curve  $p_{2S}$  would allow such a secondary pressure only which would be only half of the maximum secondary pressure  $p_{\max}$ .

10

15

The details of the invention may vary within the framework of the inventional idea as defined in the following claims.

## Claims

1. A pressure converter for hydraulic brakes, particularly for brakes of a tractor, which converter comprises a body (10) and a piston device (15) located in the borings or similar of the body, which piston device has a primary compartment (24) and a secondary compartment (27), the piston of the primary compartment having an essentially larger area of the cross-section ( $A_1$ ) than the secondary compartment ( $A_2$ ), and the primary pressure ( $p_1$ ) being conducted to the primary compartment (24) from the brake system master cylinder or similar, and the amplified secondary pressure ( $p_2$ ) being conducted from the secondary compartment (27) to the wheel cylinder, wherein the pressure converter is equipped with pressure-limiting organs (25,26,27), by means of which the secondary pressure ( $p_2$ ) is limited according to the maximum allowed secondary pressure ( $p_{2max}$ ), and that the conversion ratio ( $A_1/A_2$ ) of the converter is selected high enough to essentially provide the maximum allowed secondary pressure ( $p_{2max}$ ) with primary pressures ( $p_{11}$ ) available in normal brakings.
2. A pressure converter in accordance with claim 1, wherein the equipment for limiting the secondary pressure ( $p_2$ ) comprise a channel (25), which connects the secondary compartment (27) to the primary compartment (24), and wherein valve equipment (26,27), arranged so as to be essentially opened at the highest allowed secondary pressure ( $p_{2max}$ ), is fitted into said channel.
3. A pressure converter in accordance with claim 1 or 2, wherein in the piston equipment (15) of the pressure converter there is a channel (18), in association with which there is a valve device (19,21,22), and that the pressure converter comprises a spring organ (20), which, as the primary compartment (24) is depressurized, presses the piston device (15) to such a position in which said valve device is opened and said channel (18) connects the primary compartment (24,27) in such a way that at low primary pressure ( $p_1 < p_{10}$ ) the conversion ratio of the converter is approx. 1, which conversion ratio is used to close the linkage clearances of the brake system in the initial phase of braking.

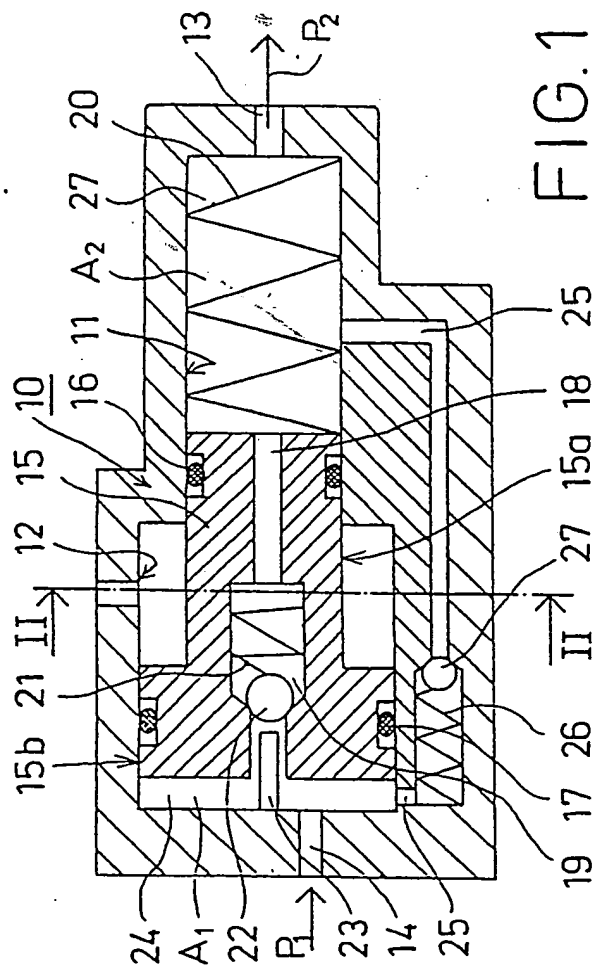


FIG. 1

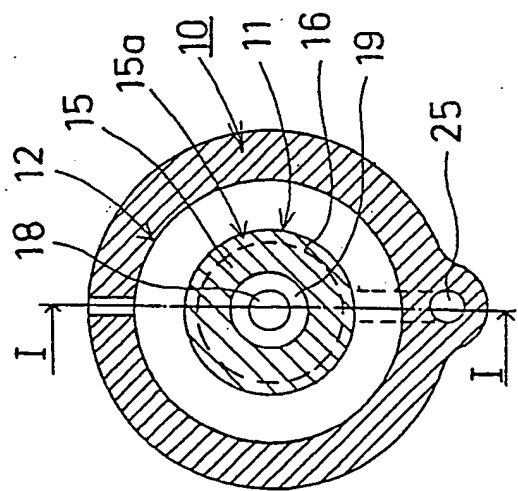


FIG. 2

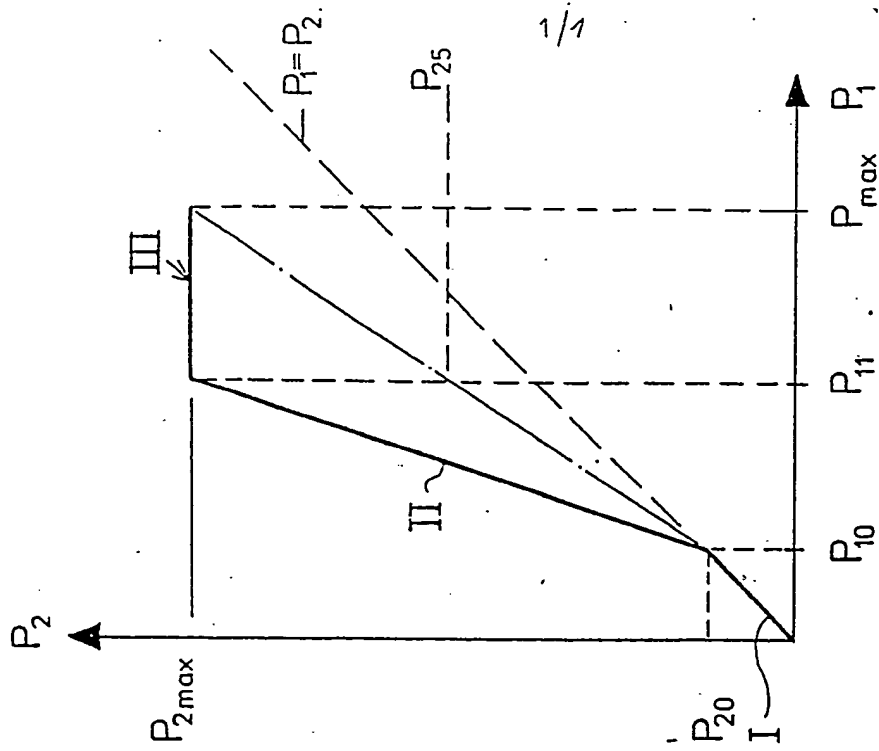


FIG. 3



# INTERNATIONAL SEARCH REPORT

International Application No PCT/FI80/00012

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (If several classification symbols apply, indicate all) <sup>1</sup>		
According to International Patent Classification (IPC) or to both National Classification and IPC 3		
B 60 T 11/28		
<b>II. FIELDS SEARCHED</b>		
Minimum Documentation Searched <sup>4</sup>		
Classification System	Classification Symbols	
IPC 3	B 60 T 11/28, G 05 D 16/16, F 16 K 31/363, 31/383	
US C1	303-6, 60-564, 590, 137-116,5, 117, 4931-9	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched <sup>5</sup>		
SE, NO, DK, FI classes as above		
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT</b> <sup>14</sup>		
Category <sup>*</sup>	Citation of Document, <sup>16</sup> with Indication, where appropriate, of the relevant passages <sup>17</sup>	Relevant to Claim No. <sup>15</sup>
A	DE, B, 2 363 001 published 1974, July 11, Nissan Motor Co	1
A	DE, A, 2 422 190 published 1975, November 27, Braukmann Heinrich	2
A	US, A, 4 133 343 published 1979, January 9, General Motors Corp	2
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p><sup>*</sup> Special categories of cited documents: <sup>16</sup></p> <p>"A" document defining the general state of the art</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document cited for special reason other than those referred to in the other categories</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> </div> <div style="width: 45%;"> <p>"P" document published prior to the international filing date but on or after the priority date claimed</p> <p>"T" later document published on or after the international filing date or priority date and not in conflict with the application, but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance</p> </div> </div>		
<b>IV. CERTIFICATION</b>		
Date of the Actual Completion of the International Search <sup>3</sup>		Date of Mailing of this International Search Report <sup>2</sup>
1981-02-02		1981-02-12